

REMARKS

Claims 1, 14, 17, 28, 40, 44, 47, 53, 57, 60, and 66 are amended. Claims 67-77 were previously cancelled without prejudice to their underlying subject matter. Claims 1-66 are now pending in this application.

Claims 1, 2, 8, 9, 14-18, 23-24, 28-31, 33, 39-41, 44-49, 53, 54, 57-61, 63, and 64 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,079,481 (Moslehi). Applicant respectfully traverses this rejection.

Claim 1, as amended, defines a method of forming a microstructure by micromachining and recites "providing a substrate in a processing chamber, said substrate comprising an etchable material and having at least one contoured feature; generating a stable ion-containing etching plasma in said processing chamber, said plasma etching the contoured feature of said substrate; generating a magnetic field, said magnetic field being adjustable in intensity and direction; applying an RF bias power to said substrate, said RF bias power being adjustable in intensity; and controlling said etching of the contoured feature by creating an electron differential at said contoured feature by adjusting at least one of said magnetic field intensity, magnetic field direction, and RF bias power intensity during said etching." This claimed method is not disclosed by Moslehi.

While techniques incorporating the simultaneous use of plasma, magnetic field, and RF biasing have been used in the prior art for etching semiconductor substrates, these prior art techniques, such as that disclosed by Moslehi, are not the same as the method of claim 1 and cannot achieve the same results. Moslehi is a good example of a prior art technique in that its disclosed processing method uses a magnetic field, which can be manipulated by using iron pins. As disclosed in the reference, the

magnetic field of Moslehi is manipulated to be uniform so that a plasma is localized over a wafer and kept away from reactor surfaces (which could cause contamination), without the need for increasing RF power, which is indicated by Moslehi to be undesirable (column 5, lines 18-30). The Moslehi process is described as being advantageous in that “it fully avoids localized and large-scale (global) semiconductor wafer process nonuniformities.” (column 5, lines 31-35).

Nowhere does Moslehi disclose “providing a substrate . . . having at least one contoured feature.” Such is not even contemplated by Moslehi. Although the Office Action (see e.g., page 2) addresses the contoured substrate limitation of claim 1, it is clear that the Office Action is discussing depressions and protrusions formed by an etching process, not contours on a substrate provided before the etching process is performed, as claimed. For this reason alone, Moslehi does not anticipate claim 1.

Additionally, Moslehi does not disclose the controlling of the etching of a contoured feature of a substrate by forming an electron differential at the contoured feature, as recited by claim 1. First, Moslehi provides no contoured feature at which to create an electron differential. Second, the magnetic field disclosed by Moslehi forces free electrons to experience a cycloidal motion parallel to the wafer surface (column 13, lines 29-31), which would not result in forming an electron differential on a contoured feature, even if such a feature was disclosed. Thus, for this reason as well, Moslehi does not anticipate claim 1.

For the above reasons, Moslehi does not anticipate claim 1 and independent claim 1 and depending claims 2-27 are patentable over this reference. Therefore, Applicant respectfully requests that the 35 U.S.C. § 102(b) rejection of claims 1, 2, 8, 9, 14-18, and 23-24 over Moslehi be withdrawn.

Claim 28, as amended, defines a method of forming a fabricated device and recites “providing a contoured workpiece; generating a stable plasma, said plasma comprising free electrons and ions, said free electrons having a velocity toward said workpiece; generating a magnetic field at said workpiece and within said plasma; forming a high negative charge density region on a contoured region of said workpiece by effecting the path of travel of said free electrons with said magnetic field; and changing the location of said high negative charge density region by changing a direction of said magnetic field while etching said workpiece with said plasma.” This method is not anticipated by Moslehi.

As discussed above in relation to the patentability of claim 1, Moslehi does not disclose “providing a contoured workpiece.” For this reason alone, Moslehi does not anticipate claim 28. Additionally, Moslehi does not disclose “forming a high negative charge density region on a contoured region of [a] workpiece” as recited in the claim. As described by the present application, a high negative charge density region can be formed by “collecting” free electrons at a surface of a feature on the wafer surface, i.e., a contoured region. Nothing of this sort is disclosed by Moslehi. As already discussed, any free electrons of the plasma disclosed by Moslehi swirl with a cycloidal motion parallel to the surface of the wafer (column 13, lines 29-31), which is quite different from the claimed method. Further, since Moslehi failed to disclose a high negative charge region at a contoured region of a workpiece, it also does not disclose “changing the location of said high negative charge density region” as recited by claim 28. For each of these reasons, Moslehi does not anticipate claim 28.

Since claim 28 is not anticipated by Moslehi, this independent claim and dependent claims 29-52 are patentable thereover. Applicant respectfully requests that the 35 U.S.C. § 102(b) rejection of claims 28-31, 33, 39-41, and 44-49 be withdrawn.

Claim 53, as amended, defines a method of plasma etching a material layer to form a microstructure and recites “providing a material layer having at least one contour; flowing gas into a chamber containing said material layer; generating a stable etching plasma from said gas, wherein said plasma comprises free electrons and ions; etching said material layer at said at least one contour with said plasma; and varying a location of said etching during said etching by varying the location of impingement of said free electrons on said material layer. This method is not anticipated by Moslehi.

Moslehi does not disclose limitations of claim 53 such as “providing a material layer having at least one contour” and “varying a location of said etching during said etching by varying the location of impingement of said free electrons on said material layer.” These limitations are similar to those of claims 1 and 28, discussed above. Therefore, for the same or similar reasoning as set forth above in relation to the patentability of claims 1-52, independent claim 53 and dependent claims 54-65 are likewise patentable over Moslehi. Applicant respectfully request that the 35 U.S.C. § 102(b) rejection of claims 53, 54, 57-61, 63, and 64 be withdrawn.

Claims 1-11, 14-18, 21, 23-26, 28-38, 40-41, 44-51, 53, 54, and 57-66 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,662,819 (Kadomura). Applicant respectfully traverses this rejection.

Kadomura is another example of a prior art technique for basic anisotropic etching using a magnetic field, plasma, and RF biasing. However, this reference, like Moslehi, is not directed to the etch control invention of the present application and, in fact, teaches away from the subject matter covered by the claims.

The method of claim 1 (claim language is set forth above in response to rejection over Moslehi) is not anticipated by Kadomura. Kadomura does not disclose forming a microstructure, as defined by claim 1, but is directed to basic anisotropic etching. Kadomura does not disclose the controlling of etching of a contoured feature of a substrate, but is specifically directed to not etching such a contoured feature. Kadomura specifically states that an objective of its disclosed method is to prevent the side-etching or undercutting of features on a substrate (column 1, lines 44-49; column 12, lines 33-44; Figures 1, 8a, 8b, and 8c). Thus, according to Kadomura, there is no etching of any contoured feature of a provided substrate, as recited by claim 1. Also, Kadomura does not disclose forming an electrical differential at a contoured feature. For each of these reasons, independent claim 1 and depending claims 2-27 are patentable over Kadomura. Applicant respectfully requests that the 35 U.S.C. § 102(b) rejection of claims 1-11, 14-18, 21, and 23-26 be withdrawn.

The method of claim 28 (claim language is set forth above in response to rejection over Moslehi) is not anticipated by Kadomura. Nowhere does Kadomura disclose the recited "forming a high negative charge density region on a contoured region of said workpiece by effecting the path of travel of said free electrons." This limitation is simply not contemplated by the simple anisotropic etching method of Kadomura. Also, Kadomura does not disclose "changing the location of said high negative charge density region" as recited by claim 28. For at least these reasons, Kadomura does not anticipate independent claim 28 or dependent claims 29-52. Applicant respectfully requests that the 35 U.S.C. § 102(b) rejection of claims 28-38, 40-41, and 44-51 be withdrawn.

The method of claim 53 (claim language is set forth above in response to rejection over Moslehi) is not anticipated by Kadomura. Again, as with claims 1 and 28 just discussed, Kadomura does not disclose etching a material layer at a contour.

Additionally, Kadomura does not disclose “varying the location of said etching . . . by varying the location of impingement of said free electrons” as recited by claim 53. For at least these reasons, Kadomura does not anticipate independent claim 53 or depending claims 53-65. Applicant respectfully requests that the 35 U.S.C. § 102(b) rejection of claims 53, 54, and 57-66 be withdrawn.

Claim 66 defines a method of forming a plasma etched device and recites, in part, “generating a magnetic field at said workpiece and controlling said magnetic field in intensity and direction to vary a location of impingement of said free electrons on said workpiece, a location of impingement of said ions on said workpiece being effected by the location of impingement of free electrons on said workpiece; and applying an RF bias power to said workpiece during ion etching and adjusting, said RF bias power during etching to vary the intensity of etching.” These recited limitations of the method of claim 66 are simply not disclosed anywhere in Kadomura. Kadomura does not disclose any impingement of free electrons on a workpiece or utilization of such impingement to effect the etching of a contoured portion of a workpiece. For at least these reasons, claim 66 is not anticipated by Kadomura and the rejection thereof under 35 U.S.C. § 102(b) is respectfully requested to be withdrawn.

Claims 1-66 stand rejected under 35 U.S.C. § 103(a) as being drawn to unpatentable subject matter over Kadomura. Applicant respectfully traverses this rejection.

The subject matter of claims 1-66 would not have been obvious over Kadomura for at least the same reasoning as set forth above in relation to the patentability of these claims over Kadomura for lack of anticipation. Kadomura does not teach or suggest etching a contoured feature of a substrate as covered by claims 1-

65. In fact, Kadomura specifically teaches away from this as one of its principle objectives; it specifically states that side etching or undercutting substrate features is a disadvantage of the prior art overcome by Kadomura's process. Also, Kadomura does not teach or suggest forming an electron differential at a contoured feature, as covered by claim 1. Additionally, Kadomura does not teach or suggest "forming a high negative charge density region" or "changing the location of said high negative charge density region" as covered by claims 28-52. Also, Kadomura does not teach or suggest "varying a location of said etching [at a contour] . . . by varying the location of impingement of said free electrons" as covered by claims 53-65 or varying "the location of impingement of said free electrons on said workpiece" as covered by claim 66. For at least these reasons, the subject matter of claims 1-66 would not have been obvious over Kadomura and is patentable thereover. Applicant respectfully requests that the 35 U.S.C. § 103(a) rejection of claims 1-66 be withdrawn.

Claims 1, 2, 5, 8, 9, 12-31, 33, and 39-65 stand rejected under 35 U.S.C. § 103(a) as being drawn to unpatentable subject matter over Moslehi. Applicant respectfully traverses this rejection.

The subject matter of claims 1-65 would not have been obvious over Moslehi for at least the same reasoning as set forth above in relation to the patentability of these claims over Moslehi for lack of anticipation. For example, Moslehi does not teach or suggest providing or etching a contoured feature of a substrate, as covered by each of claims 1-65. Moslehi does not teach or suggest forming an electron differential at a contoured feature of a substrate as covered by claims 1-27. Additionally, Moslehi does not teach or suggest forming a high negative charge density region on a contoured region of a substrate or changing the location of such a region, as covered by claims 28-

52. Also, Moslehi does not teach or suggest the impingement of free electrons on a material layer or varying the location of etching such a material layer by varying the location of impingement of said free electrons as covered by claims 53-65. Thus, for each of these reasons, at least, the subject matter of claims 1-65 would not have been obvious over Moslehi. Applicants respectfully request that the 35 U.S.C. § 103(a) rejection of claims 1, 2, 5, 8, 9, 12-31, 33, and 39-65 be withdrawn.

Finally, the Applicant notes the Office Action statement that the claims as broadly cited do not claim a method commensurate in scope with the method as shown in Figures 9 and 10. Applicant does not understand the significance of this statement, but responds that Figures 9 and 10 illustrate examples of results that can be achieved using the methods claimed.

In view of the above, each of the presently pending claims (1-66) in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

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